

FORM PTO-1390
(REV 10-95)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

**TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. §371**

F7483(V)

U.S. APPLICATION NO. (if known, see 37 CFR §1.5)

09/889977

INTERNATIONAL APPLICATION NO.

INTERNATIONAL FILING DATE

PCT/EP99/10288

20 DECEMBER

PRIORITY DATE CLAIMED

26 JANUARY 1999

TITLE OF INVENTION

QUICK COOKING RICE AND PROCESS TO MAKE

APPLICANT(S) FOR DO/EO/US

BLONK, Johannes, et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. §371.
 2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. §371.
 3. ☐ This express request to begin national examination procedures (35 U.S.C. §371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. §371(b) and PCT Articles 22 and 39(1).
 4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
 5. ☒ A copy of the International Application as filed (35 U.S.C. §371(c)(2))
 - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ has been transmitted by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
 6. ☐ A translation of the International Application into English (35 U.S.C. §371(c)(2)).
 7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. §371(c)(3))
 - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
 - b. ☒ have been transmitted by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☐ have not been made and will not be made.
 8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. §371(c)(3)).
 9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. §371(c)(4)).
 10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. §371(c)(5)).
- Items 11. to 16. below concern document(s) or information included:
11. ☐ An Information Disclosure Statement under 37 C.F.R. §§1.97 and 1.98.
 12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 C.F.R. §§3.28 and 3.31 is included.
 13. ☒ A **FIRST** preliminary amendment.
 - ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
 14. ☐ A substitute specification.
 15. ☐ A change of power of attorney and/or address letter.
 16. ☐ Other items or information:

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U.S. APPLICATION NO. (If known) 09/7889977

INTERNATIONAL APPLICATION NO.

PCT/EP99/10288

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F7483(V)

17. ☒ The following fees are submitted:**BASIC NATIONAL FEE (37 CFR §1.492 (a) (1) - (5)):**

Search Report has been prepared by the EPO or JPO..... \$860.00

International preliminary examination fee paid to USPTO (37 CFR §1.482)..... \$690.00

No international preliminary examination fee paid to USPTO (37 CFR §1.482) but international search fee paid to USPTO (37 CFR §1.445(a)(2))..... \$710.00

Neither international preliminary examination fee (37 CFR §1.482) nor international search fee (37 CFR §1.445(a)(2)) paid to USPTO..... \$1000.00

International preliminary examination fee paid to USPTO (37 CFR §1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)..... \$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =

\$860.00

Surcharge of \$130.00 for furnishing the oath or declaration later than months from the earliest claimed priority date (37 C.F.R. §1.492(e)).

☐ 20☐ 30

CLAIMS

NUMBER FILED

NUMBER EXTRA

RATE

Total claims 24 - 20 = 4 x \$ 18.00 \$72.00

Independent claims 2 - 3 = 0 x \$ 80.00 \$0.00

MULTIPLE DEPENDENT CLAIM(S) (if applicable)

+ \$ 270.00

TOTAL OF ABOVE CALCULATIONS = \$932.00

Reduction of 1/2 for filing by small entity, if applicable. A Verified Small Entity Statement must also be filed (Note 37 C.F.R. §§1.9, 1.27, 1.28).

SUBTOTAL = \$932.00

Processing fee of \$130.00 for furnishing the English translation later than months from the earliest claimed priority date (37 C.F.R. §1.492(f)).

☐ 20☐ 30**TOTAL NATIONAL FEE =** \$932.00

Fee for recording the enclosed assignment (37 C.F.R. §1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 C.F.R. §§3.28, 3.31). \$40.00 per property.

TOTAL FEES ENCLOSED = \$932.00

Amount to be refunded:

charged:

a. ☐ A check in the amount of _____ to cover the above fees is enclosed.b. ☒ Please charge my Deposit Account No. 12-1155 in the amount of 932.00 to cover the above fees. A duplicate copy of this sheet is enclosed.c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 12-1155. A duplicate copy of this sheet is enclosed.**NOTE: Where an appropriate time limit under 37 C.F.R. §§1.494 or 1.495 has not been met, a petition to revive (37 C.F.R. §1.137(a) or (b)) must be filed and granted to restore the application to pending status.**

SEND ALL CORRESPONDENCE TO:

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REPRESENTATIVE CAPACITY FOR UNILEVER

Filed: 25 JULY 2001

27,969

REGISTRATION NUMBER

AJZ:kmo

IN THE UNITED STATES DESIGNATED/ELECTED OFFICE

International Application No. : PCT/EP99/10288
International Filing Date : 20 DECEMBER 1999
Priority Date(s) Claimed : 26 JANUARY 1999
Applicant(s) (DO/EO/US) : BLONK, Johannes, et al.
Title: QUICK COOKING RICE AND PROCESS TO MAKE

PRELIMINARY AMENDMENT

Commissioner for Patents
Washington, D.C. 20231

SIR:

Prior to calculating the national fee, and prior to examination in the National Phase of the above-identified International application, please amend as follows:

IN THE CLAIMS:

Please amend the claims as follows:

3. (Amended) Quick cooking rice according to claim 1 having a porosity so that 20-50%, preferably 25-40% of the surface of the cross-section consists of pores of 1-5 microns.

4. (Amended) Quick cooking rice as obtainable by performing the process according to claim 13.

7. (Amended) Quick cooking rice kernels according to claim 5, wherein the number of longitudinal cracks per rice kernel is less than 10, preferably 2 to 7.

8. (Amended) Quick cooking rice kernels according to claim 5, wherein the rim has a thickness of 10 to 250 microns, preferably 100 to 150 microns.

9. (Amended) Quick cooking rice kernels according to claim 5 wherein the sponge like structure contains per kernel less than 5, preferably less than 3 holes with a size of more than 500 microns.

10. (Amended) Quick cooking rice kernels according to claim 5, wherein the sponge like mass consists of small holes from which more than 75% have a diameter of 1 to 100 microns.

11. (Amended) Quick cooking rice kernels according to claim 5 wherein the kernels have a bulk density of 0.4 to 0.75 kg/l, preferably 0.45 to 0.70 kg/l.

12. (Amended) Quick cooking rice kernels according to claim 5, wherein the kernels have a considerable internal coherence so that after cooking for 8 min at about 100°C less than 20% of the rice kernels, preferably less than 15% are broken as a result of the cooking.

13. (Amended) Process for making quick cooking rice or quick cooking rice kernels with the properties of the rice or the rice kernels from claim 1, wherein milled or polished rice kernels are subjected to a heat treatment in a hot inert gas stream while being in an annular, fluidised bed with a limited height.

14. (Amended) Process according to claim 13, wherein rice kernels are subjected to a heat treatment in a hot gas stream in a treatment chamber and wherein the rice kernels are subjected to the heat treatment while being in an annular, fluidised, swirling, toroidal bed with a limited height and wherein the rice kernels have horizontal and vertical velocity components.

15. (Amended) Process according to claim 13, wherein the rice kernels are heated to 200-350°C, preferably 240-310°C.

16. (Amended) Process according to claim 13, wherein the rice kernels are treated for 10-60 sec, preferably 15-50 sec, most preferably 20-45 sec in the treatment chamber.

17. (Amended) Process according to claim 13, wherein air is applied as gas.

18. (Amended) Process according to claim 13 wherein the gas is used with a velocity of less than 50 m/sec, preferably less than 25 m/sec.

19. (Amended) Process according to claim 13, wherein the gas is recirculated in the process during and after separation of the rice kernel particles.

20. (Amended) Process according to claim 13, wherein the gas is recirculated using an air impeller with a rotation speed of 60 Herz or less, preferably 50 herz or less.

21. (Amended) Process according to claim 13, wherein the water content of the starting rice kernels is 5-40 wt%, preferably 10-20 wt%.

22. (Amended) Rice containing meals, wherein the rice in the meals is a cooked rice obtained after quick cooking of the rice or the rice kernels according to claim 1.

Please add the following new claims 23-24:

--23. Process for making quick cooking rice or quick cooking rice kernels with the properties of the rice or the rice kernels from claim 5, wherein milled or polished rice kernels are subjected to a heat treatment in a hot inert gas stream while being in an annular, fluidised bed with a limited height.

24. Process according to claim 23, wherein rice kernels are subjected to a heat treatment in a hot gas stream in a treatment chamber and wherein the rice kernels are subjected to the heat treatment while being in an annular, fluidised, swirling, toroidal bed with a limited height and wherein the rice kernels have horizontal and vertical velocity components.--

REMARKS

The purpose of this Preliminary Amendment is to eliminate multiple dependent claims in order to avoid the additional fee. Applicants reserve the right to reintroduce claims to canceled combined subject matter.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached pages are captioned "**Version With Markings to Show Changes Made**".

Respectfully submitted,



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AJZ:jmm

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

Claims 3-4 and 7-22 have been amended as follows:

3. (Amended) Quick cooking rice according to claims 1-2 having a porosity so that 20-50%, preferably 25-40% of the surface of the cross-section consists of pores of 1-5 microns.
4. (Amended) Quick cooking rice as obtainable by performing the process according to ~~one or more of the process claims 13-21~~ 13.
7. (Amended) Quick cooking rice kernels according to claims 5-6, wherein the number of longitudinal cracks per rice kernel is less than 10, preferably 2 to 7.
8. (Amended) Quick cooking rice kernels according to claims 5-~~7~~, wherein the rim has a thickness of 10 to 250 microns, preferably 100 to 150 microns.
9. (Amended) Quick cooking rice kernels according to claims 5-~~8~~ wherein the sponge like structure contains per kernel less than 5, preferably less than 3 holes with a size of more than 500 microns.
10. (Amended) Quick cooking rice kernels according to claims 5-~~9~~, wherein the sponge like mass consists of small holes from which more than 75% have a diameter of 1 to 100 microns.
11. (Amended) Quick cooking rice kernels according to claims 5-~~10~~ wherein the kernels have a bulk density of 0.4 to 0.75 kg/l, preferably 0.45 to 0.70 kg/l.
12. (Amended) Quick cooking rice kernels according to claims 5-~~11~~, wherein the kernels have a considerable internal coherence so that after cooking for 8 min at about 100°C less than 20% of the rice kernels, preferably less than 15% are broken as a result of the cooking.

13. (Amended) Process for making quick cooking rice or quick cooking rice kernels with the properties of the rice or the rice kernels from ~~respectively-claims 1-to-4 and claims 5-12~~, wherein milled or polished rice kernels are subjected to a heat treatment in a hot inert gas stream while being in an annular, fluidised bed with a limited height.

14. (Amended) Process according to claims 13 ~~for the preparation of a quick cooking rice or quick cooking rice kernels with the properties as defined in respectively claims 1-4 and 5-12~~, wherein rice kernels are subjected to a heat treatment in a hot gas stream in a treatment chamber and wherein the rice kernels are subjected to the heat treatment while being in an annular, fluidised, swirling, toroidal bed with a limited height and wherein the rice kernels have horizontal and vertical velocity components.

15. (Amended) Process according to claims ~~13-14~~ 13, wherein the rice kernels are heated to 200-350°C, preferably 240-310°C.

16. (Amended) Process according to claims ~~13-14~~ 13, wherein the rice kernels are treated for 10-60 sec, preferably 15-50 sec, most preferably 20-45 sec in the treatment chamber.

17. (Amended) Process according to claims ~~13-16~~ 13, wherein air is applied as gas.

18. (Amended) Process according to claims ~~13-17~~ 13 wherein the gas is used with a velocity of less than 50 m/sec, preferably less than 25 m/sec.

19. (Amended) Process according to claims ~~13-18~~ 13, wherein the gas is recirculated in the process during and after separation of the rice kernel particles.

20. (Amended) Process according to claims ~~13-19~~ 13, wherein the gas is recirculated using an air impeller with a rotation speed of 60 Herz or less, preferably 50 herz or less.

21. (Amended) Process according to ~~claims 13-20~~ 13, wherein the water content of the starting rice kernels is 5-40 wt%, preferably 10-20 wt%.

22. (Amended) Rice containing meals, wherein the rice in the meals is a cooked rice obtained after quick cooking of the rice or the rice kernels according to ~~respectively claims 1-4 and 5-12~~, claim 1.

Claims 23- 24 have been newly added and therefore no marked-up version is necessary.

09/889977

Quick cooking rice and process to make

Rice is in many countries the main component of the daily meal. In general an untreated rice is used in these countries to prepare their rice based meals. Herefor the untreated rice is added to water or boiling water, the mixture is brought to boil and the rice is cooked. In general the cooked rice (after all water is absorbed by rice) is kept to stand for some time which is described as "standing time". This whole process takes about 15-40 min for white milled rice and results in a cooked rice with very good product characteristics such as cohesion, adhesion, springiness, even texture without grittiness/sandiness, white colour and taste.

The scores used to describe the attributes (i.e.: cohesion, adhesion, springiness, grittiness and even texture) of rice prepared under the optimum conditions are defined on a scale of 1 to 5, as evaluated sensorially by an expert panel (cf table 2).

Cohesion is described as the ability of the rice after cooking to hold together as a mass during mastication. Score 1 means separate kernels and no cohesion, while 5 means the formation of a clump in the mouth and much cohesion.

Adhesion is defined as the degree to which a sample of cooked rice holds together when first placed in the mouth and then separates into individual pieces when manipulated with the tongue. Score 1 is given for samples with an empty mouthfeel, giving a kind of "melting" behaviour when put

into the mouth, while the score 5 is reserved for samples with a "full" mouthfeel and a clearly present mass in the mouth.

Springiness is defined as the degree to which a grain of cooked rice returns to its original shape after it has been compressed by the teeth, wherein score 1 means no return of the kernel and 5 an almost elastic behaviour of the kernel like eg. well prepared parboiled rice.

Grittiness is defined as the degree to which rice gives a perception of sandy or gritty particles in the mouth during chewing and after swallowing the largest part of the mass.

Firmness (or hardness) being defined as the force required to bite through a rice kernel after cooking.

Even texture of the cooked rice is defined by the presence of individual kernels which are noticeable during mastication as a mass of rice with an overall homogeneous structure, and by the absence of parts of the kernel being eg. harder, more elastic or gritty.

Other parameters that are used to describe the new rice are:

- the porosity of the uncooked rice kernels as measured by scanning electron microscopy. This porosity is measured on the cross-surface of a rice kernel, after cutting the kernel into two parts with e.g. a razor blade, and is expressed as the average percentage of the cross-surface that is taken in by pores with a pore size of 1-100

microns, preferably 1-50 microns, most preferably 1-5 microns.

- the colour of the rice grains as measured by a colorimeter according to the CIE (Commission Internationale de l'Eclairage), giving L, a, b values. The L-value indicates "lightness" of the sample, on a scale from black to white. a and b values are the chromaticity coordinates. +a is red direction, - a is green direction, +b is the yellow direction and -b the blue direction (cf table 1).

The time of 15-25 min for the preparation of a cooked rice is considered nowadays as unacceptably long. Therefore, attempts were made to find new processes resulting in new types of rice that would reduce the preparation times thereof. These attempts resulted in for example the finding of an instant rice made by a wet process (EP 17040) wherein the rice is soaked, cooked with excessive water, steamed and subsequently dried or by a gun puffing process (US 4520574) wherein the rice is conditioned up to about 20% moisture and expanded in a puffing gun at low pressure.

The instant rice so obtained could be prepared for eating by adding boiling water to the rice, stirring the mixture and standing for 5 min. However, the rice so obtained had a number of drawbacks such as the rice showed little adhesion and was soft, while the rice displayed hardly any springiness, which is required to achieve an acceptable eating performance and was watery and tasteless

In an alternative process a quick cooking rice was obtained by a wet processing wherein the rice is cooked up to 30-40% moisture, rolled, bumped to flatten and subsequently

dried (EP 672353). This product could be cooked within 7-25 min which includes cooking and standing time, depending on the nature of the rice used. In general the preparation time consists of several types of treatments at fixed times, which thus it is not very convenient. Moreover, the products obtained displayed insufficient mouthfeel and taste, while the springiness and cohesion of the product was unacceptable.

According to a last alternative method a quick cooking rice was made by subjecting a rice to direct hot air at 400-600 °C in at least two cyclones for 10-15 sec (US 4478862). The rice so obtained could be cooked within 4-8 min, but the cooked rice displayed grittiness and showed during cooking an uneven appearance due to presence of chalky grains as well as transparent grains at the same time. Further had the rice an uneven structure, especially in rice varieties like Indonesian IR64, resulting in an uneven thickness of the outer, not sponge-like region of the kernel, in the presence of very large holes (> 1 mm), and cracks extending from the outer region deep into the sponge-like interior of the kernel, and resulting in undesired broken rice kernels during cooking.

Therefore, we studied whether we could find a new process that would produce a rice without the disadvantages set out above. This study resulted in the finding of such a new process and in the development of a new rice that combined, after cooking good cohesion properties with a very good bite and springiness, which was not gritty and did not display off-taste properties. Moreover, this rice displayed a very advantageous microporous structure under a microscope having a high percentage of pores with a pore

size of most preferably 1-5 microns. Therefore the rice was very white to light yellow after cooking. It also was found that the above process, when applied to different types of rice (e.g. Indian, Indonesian, Thai, Vietnamese, Chinese, Korean, Japanese, Brazilian, Egyptian, Kenian etc), although all resulting in a rice with the desired eating and cooking properties, also resulted in quick cooking rices that fulfil different compound parameters. Therefore the quick cooking rice according to the invention can be described in alternative ways, however all being part of our novel invention.

Table 1 shows the results of a colour measurement of the untreated and treated rice of two types: Indonesian (IR64) and Thai (Jasmine) rice. Comparison in colour is given for untreated and treated rice products (which were treated according to the dry process mentioned above) and for rice made by the process of this invention.

Table 1: Colour measurement of cooked and uncooked IR64 and Jasmine rice

	Rice type	uncooked			cooked rice		
		L	a	b	L	a	b
1	IR 64 untreated	69.5	-0.79	10.6	74.4	-2.02	3.8
2	IR 64 invention	84.3	-0.91	12.4	67.4	-1.67	5.7
3	IR 64 dry process	75.9	0.22	16.7	67.1	-1.13	9.9
4	Jasmine untreated	67.3	-1.51	10.3	72	-2.0	2.5
5	Jasmine invention	88	-1.33	10.2	69.3	-1.93	6.7
6	Jasmine dry process	86.5	-1.06	11	69.9	-1.58	7.9

As shown in Table 1 the new rice made by the process of this invention for both types of rice (IR64 and Jasmine) has lower +b values, i.e. less yellowness than the rice made by the dry process independently whether this new rice is cooked or uncooked. In addition this new rice has also the lower -a value than the rice made by the dry process. The overall result (with the exception of the L value) of this measurement shows that the new rice made by the process of this invention displayed the color appearance closer to the reference untreated rice than the rice made by the dry process did.

According to a first embodiment of our invention this new rice can be defined as formulated in claim 1. i.e. our novel quick cooking rice has a preparation time for eating purposes of less than 10 min, preferably less than 8 min and displays after cooking good overall eating properties, and has the appearance of natural, untreated rice and includes one or more of the following properties:

- (i) a springiness for the cooked quick cooking rice comparable with that of a cooked untreated rice
- (ii) a pore distribution for the uncooked, quick cooking rice so that more than 18% of the surface of a cross-section is taken in by pores with a size of 1-100 microns, preferably 1-50 microns, most preferably 1-5 microns
- (iii) a white or light yellow colour after cooking
- (iv) free of grittiness after cooking
- (v) a firmness after cooking comparable with that of cooked untreated rice

According to a second embodiment of our invention alternative types of quick cooking rice can be described as quick cooking expanded rice kernels with a preparation time for eating purposes of less than 10 min and before cooking having:

- an outersurface with cracks predominantly in the longitudinal direction of the rice kernels
 - an internal sponge like structure surrounded by a massive rim, which sponge like structure has a pore distribution such that the mass of the sponge like structure is free of transversal cracks and contains no or only a few holes with a size of more than 500 microns, while the rest of the sponge like structure consists of small pores
- a bulk density that is more than 10 %, preferably more than 20 % and most preferably more than 25 % less than the bulk density of the natural rice it originates from.

The pore distribution is preferably such that 20-50%, more preferably 25-40% of the surface of the cross-section consists of pores with a size of 1-5 microns. This could be concluded from photos made from our novel rice, and

comparison with photos of untreated rice. Rice kernels are observed using a scanning electron microscope. The outer surface is observed without any pretreatment of the kernel, the interior structure after breaking the kernel in longitudinal direction using a sharp razor blade. The rim is defined as the not sponge-like outer part of the kernel.

Our novel quick cooking rice according to our second embodiment displayed cracks mainly in the longitudinal direction of the rice kernels. These cracks, present in the dense outer layer or rim of the kernel only, have a width of 5 to 300 microns, in particular of 15 to 200 microns and have a depth of 100 to 250 microns, in particular of 130 to 200 microns. The number of these cracks per rice kernel varies between 0 and 10 but in general this number is between 2 and 7.

The novel rice kernels according to this embodiment of the invention have as a characteristic that they have a massive rim around a sponge like structure. This massive rim has a thickness of 10 to 250 microns, preferably of 50 to 200 microns, more preferably of 100 to 150 microns.

The sponge like structure contains per kernel less than 5, preferably less than 3 holes with a size of more than 500 microns. The presence of these holes seems disadvantageous for the strength of the rice kernels as comes out in the amount of damaged rice kernels in particular as obtained after cooking of the rice. In this respect it is also important that the sponge like mass is substantially or even better completely free of transversal cracks, in particular free of cracks perpendicular to the long axis of the kernel. These transversal cracks are also contributing

to the amount of broken rice kernels after cooking. Thus although cracks might be present in the rim of our novel rice kernels these cracks are substantially or completely absent in the sponge like mass. This sponge like mass substantially consists of small holes, in particular this mass consists of small holes from which more than 75 % have a diameter of 1 to 100 microns. The size of these holes is different for different varieties of rice kernels. E.g for jasmine rice these holes are smaller than for Indonesian rice. Other varieties, such as e.g. Basmati have a more homogeneous distribution of pores. We believe that these small holes (or pores) have an important function in the water absorption capacity of the rice kernels and thus in the cooking time of the rice kernels.

The novel rice kernels according to this embodiment of the invention further display a bulk density (as measured by weighting one liter of the rice kernels) of 0.4 to 0.75 kg/l, in particular of 0.45 to 0.70 kg/l. This bulk density in fact illustrates the porosity of the rice kernels. (bulk density of a natural rice is about 0.84 kg/l).

The improved appearance of our novel rice kernels can be illustrated by the fact that our novel rice kernels have a considerable internal coherence, because after cooking for about 8 min at about 100 °C in water the amount of broken rice kernels has increased with less than 20 %, in particular with less than 15 % as a result of the cooking.

Our novel rice kernels can be obtained by a process, wherein milled or polished rice kernels are subjected to a heat treatment in a hot inert gas stream while being in an annular, fluidised bed with a limited height.

According to a preferred process the kernels of rice are treated in a hot gas stream, often hot air, which is passed through means which provide a high velocity swirling action to the gas and rice kernels in the gas stream in the lower part of a process chamber. The rice kernels to be processed are suspended in the gas stream in a well defined bed formation. The underside of the bed is exposed to a high velocity impact of the gas stream, leaving the means in an area where high turbulence exists. In this area the heat transfer rate in the process is increased. The means that provide the high velocity swirling action typically have an inclined blade structure like present in turbines (however they do not move).

The fact that provisions are taken to avoid that only the underside of the bed is to be exposed to the reaction conditions, prevents that the rice kernels are heated unevenly. The use of the means with the inclined blade structure causes the rice kernels to flow according to a toroidal movement. This ensures the even heating of the rice kernels.

Very useful conditions for this process are:
treatment times of 10-60 sec, preferably 15-50 sec most preferably 20-45 sec, treatment temperatures of 200-350 °C, preferably 240-310 °C which is dependent on the batch size. Moisture contents in the starting rice ranging from 5-40 wt%, preferably 10-20 %, whereas the products are cooled after the treatment within 2-30 min, preferably within 5-20 min to 25 °C.

The principles of the toroidal bed technology are disclosed in a number of patent applications. For reference the following patents are indicated: EP 68853; EP 288141; EP 382769; EP 293103; and EP 346004. All these patents disclose toroidal bed technology that can be applied in our processing. However, none of these patents discloses the use of this technology on the preparation of quick cooking rice products. A very beneficial process for the preparation of our novel rice products is disclosed in our co-pending European patent application 99202665.8. According to this processing the rice kernels have horizontal and vertical velocity components.

Our process e.g. can be performed in a process chamber as shown in the attached drawing. Herein the starting rice kernels are introduced by hopper (1) via feeder with weight unit (2) through feed door (3) into process chamber (4). Chamber (4) is provided with a plate of blade ring (5). The center of chamber (4) is provided with heating elements (7) above which a lid (13) with openings is present. Under the heating elements (7) process fan (6) is present which is driven by an impeller motor (14).

The wall of chamber (4) is provided with an outlet feed door (8), through which the final product is removed from the chamber (4) via cooling chamber (9) to outlet (11). The cooling chamber (9) is connected with cooling fan (10). The parameters of the process condition are set and controlled with the control unit in the control cabinet (12).

During the process rice kernels are introduced via feed door (3) into chamber (4). Simultaneously a gas stream, preferably air is introduced below plate (5). The velocity

of this gas stream is controlled by impeller (14) through which fresh gas is introduced via process fan (6). The temperature of the gas is measured and controlled by recirculating part of the process gas via the openings in the lid (13) whereupon the gas is reheated if necessary by heating elements (7). The heated gas is introduced in chamber (4) via the blades in plates (5). The rice kernels that are introduced via feed door (3) are heated while they are subjected to a toroidal movement in the lower parts of chamber (4) and form a toroidal, fluidised bed. The major part of the gas however is circulated via the openings in lid (13) and is reheated by elements (7). In particular the gas is recirculated in the process during and after separation of the rice kernel particles. After the time required to perform the process the process is stopped and the product is removed via outlet feed door (8) and cooled in the cooling chamber (9).

The gas usually is applied with a velocity of less than 50m/sec, preferably less than 25 m/sec, most preferably 10 to 25 m/sec.

The gas circulation can be performed by using an air impeller with a rotation speed of 60 Herz or less, in particular 50 Herz or less.

Evaluation of the cooked rice obtained by this process demonstrated that the products after cooking have good cohesion properties, display a good bite and mouthfeel, hardly grittiness, and no off taste. The springiness of the products is also very good. In addition the processed rice shows before cooking a very advantageous pore distribution and during cooking even appearance. The starch of the processed rice is partially gelatinized.

2000

1997

Table 2 summarizes the comparison of the product properties after cooking with those of a number of known products:

Table 2: Comparison of the product properties of different rice products evaluated by the sensoric panel

product parameter	for invention	untreated rice	instant rice	wet process rice	dry process rice
cohesion/adhesion	4	5	3	1	4
firmness	4	5	1	2	4
springiness	4	5	1	2	3
grittiness	4	5	5	5	1
appearance	4	5	1	3	2
taste	4	5	1	3	3

NB:

Untreated rice referred as "reference" is scored on 5 as the maximum scale for each attribute. The lowest score of 1 is defined as the biggest difference from the reference.

EXAMPLES

1. Batches of 250 g. of Indonesian rice were treated according to described processing method given the following processing conditions: temperature of 280 °C in processing chamber, processing time of 25 sec., cooling time of 10 min of which 20 sec in forced air circulation. The treated rice was stored in closed bags until use. This rice was put in a pan with 4 to 5 times its own weight of cold water, the mixture was stirred and brought to boil.

The rice was cooked, without a lid for 7.5 minutes, depending on intensity of heat and size of pan. The mixture was occasionally stirred, especially when the water was taken up by the rice and evaporated. The rice could be eaten immediately (ie after about 2 min standing time) after cooking, when cooled down to temperatures at which rice is normally eaten.

2. Batches of 250 g. of Thai rice were treated according to described processing method given the following processing conditions: temperature of 300 °C in processing chamber, processing time of 25 sec., cooling time of 10 min of which 20 sec in forced air circulation.

The treated rice was stored in closed bags until use.

This rice was put in a pan with 4 to 5 times its own weight of cold water, the mixture was stirred and brought to boil. The rice was cooked without a lid for 6.5 to 7.5 minutes, depending on intensity of heat and size of pan.

The mixture was occasionally stirred, especially when the water is taken up by the rice and evaporated. The rice could be eaten immediately after cooking, when cooled down to temperatures at which rice is normally eaten.

3. Pandan rice was treated at 280 °C during 18 sec. according to mehod of Example 1.

Rice kernels were observed in the Scanning Electron Microscope (SEM) after proper coating with a thin metal layer (typically a few nm Pd/Pt) to prevent charging in the SEM.

The internal structure of the kernels was observed by preparing a fracture, using a sharp razor blade, in the longitudinal direction of the kernel.

Description of the structure

External.

5 till 10 (mean 7) longitudinal cracks are present in the surface of the kernels.

The length of these cracks is between 0.5 and 5 mm (mean 2 mm).

The width of these cracks ranges from < 10 till 100 μm (mean value 50 μm).

The depth of the cracks between a few μm till 100 μm .

Transversal cracks originate from deviating longitudinal cracks have similar dimensions, but in most cases these cracks converge rapidly, within a few tenths of a mm, to a width less than 10 μm . The number of these transversal cracks is between 10 and 30.

Internal

Sponge-like structure surrounded by a non-porous rim.

Thickness of the rim varies between 50 and 100 μm . In the rim the cracks are visible which have been mentioned in the description of the external surface. The cracks never continues into the sponge structure.

Holes in the sponge structure are absent or only 1 or 2 are present (mean 1).

The distribution of size of the holes ranges from 1 till 100 μm .

75% of the fracture surface (excluding the rim-region) contains holes smaller than 50 μm but larger than 5 μm . 25% of the fracture surface (excluding the rim region) contains holes smaller than 5 μm .

4. IR64 was treated at 280 °C during 30 sec. according to method of Example 1.

Rice kernels were observed in the Scanning Electron Microscope (SEM) after proper coating with a thin metal layer (typically a few nm Pd/Pt) to prevent charging in the SEM.

The internal structure of the kernels was observed by preparing a fracture, using a sharp razor blade, in the longitudinal direction of the kernel.

Description of the structure

External.

1 till 3 (mean 2) longitudinal cracks are present in the surface of the kernels.

The length of these cracks is between 4 and 6 mm (mean 5 mm)

The width of these cracks ranges from < 10 till 50 μm (mean value 30 μm).

The depth of the cracks between a few μm till 200 μm .

Transversal cracks are running perpendicular to the transversal ones and have similar depth dimensions, they are much shorter in length and in most cases these cracks converge rapidly, within a few tenths of a mm, to a width less than 10 μm . The number of these transversal cracks is between 5 and 15.

Internal

Sponge-like structure surrounded by a non-porous rim.

Thickness of the rim varies between 100 and 200 μm . In the rim the cracks are visible which have been mentioned in the description of the external surface. The cracks never continues into the sponge structure.

Holes in the sponge structure are absent or only 1 or 2 are present (mean 1).

The distribution of holes ranges from 5 till 100 μm .

85% of the fracture surface (excluding the rim-region) contains holes smaller than 100 μm but larger than 10 μm .

15% of the fracture surface (excluding the rim region) contains holes smaller than 10 μm .

5. Basmati rice was treated at 280 °C during 18 sec. according to method of Example 1.

Rice kernels were observed in the Scanning Electron Microscope (SEM) after proper coating with a thin metal layer (typically a few nm Pd/Pt) to prevent charging in the SEM.

The internal structure of the kernels was observed by preparing a fracture, using a sharp razor blade, in the longitudinal direction of the kernel.

Description of the structure

External.

3 till 10 (mean 5) longitudinal cracks are present in the surface of the kernels.

The length of these cracks is between 0.5 and 5 mm (mean 2 mm).

The width of these cracks ranges from < 10 till 100 μm (mean value 50 μm).

The depth of the cracks between a few μm till 100 μm .

A few tens longitudinal cracks are present having a width less than 10 μm .

Transversal cracks originate from deviating small longitudinal cracks have similar dimensions, but in most cases these cracks converge rapidly, within a few hundreds

micrometers to a width less than 2 μm . The number of these transversal cracks is between 50 and 100.

Internal

Sponge-like structure surrounded by a non-porous rim. Thickness of the rim varies between 200 and 300 μm . In the rim the cracks are visible which have been mentioned in the description of the external surface. The cracks never continues into the sponge structure.

In less than 10% of the rice kernels a transversal crack is observed inside the sponge structure.

In the sponge structure 1 till 4 (mean 2) holes are present having a diameter along the log axis of more than 500 μm . The distribution of size of the holes in the sponge structure ranges from 5 till 150 μm .

85% of the fracture surface (excluding the rim-region) contains holes smaller than 150 μm but larger than 20 μm .

15% of the fracture surface (excluding the rim region) contains holes smaller than 20 μm .

Claims

1. Quick cooking rice with a preparation time for eating purposes of less than 10 min and displaying after cooking good overall eating properties, and having the appearance of natural, untreated rice and including one or more of the following properties:

- (i) a springiness for the cooked quick cooking rice comparable with that of cooked untreated rice
- (ii) a pore distribution for the uncooked quick cooking rice so that more than 18% of the surface of a cross-section is taken in by pores with a size of 1-100 microns, preferably 1-50 microns, most preferably 1-5 microns
- (iii) a white to light yellow colour after cooking
- (vi) being free of grittiness after cooking
- (v) a firmness after cooking comparable with that of cooked untreated rice

2. Quick cooking rice according to claim 1 having a preparation time of less than 8 min.

3. Quick cooking rice according to claims 1-2 having a porosity so that 20-50%, preferably 25-40% of the surface of the cross-section consists of pores of 1-5 microns.

4. Quick cooking rice as obtainable by performing the process according to one or more of the process claims 13-21

5. Quick cooking expanded rice kernels with a preparation time for eating purposes of less than 10 min and before cooking having:

- an outersurface with cracks predominantly in the longitudinal direction of the rice kernels
- an internal sponge like structure surrounded by a massive rim, which sponge like structure has a pore distribution such that the mass of the sponge like structure is free of transversal cracks and contains no or only a few holes with a size of more than 500 microns, while the rest of the sponge like structure consists of small pores
- a bulk density that is more than 10 %, preferably more than 20 % and most preferably more than 25 % less than the bulk density of the natural rice it originates from.

6. Quick cooking rice kernels according to claim 5, wherein the cracks in the longitudinal direction of the rice kernels have a width of 5 to 300 microns and a depth of 100 to 250 microns.

7. Quick cooking rice kernels according to claims 5-6, wherein the number of longitudinal cracks per rice kernel is less than 10, preferably 2 to 7.

8. Quick cooking rice kernels according to claims 5 to 7, wherein the rim has a thickness of 10 to 250 microns, preferably 100 to 150 microns.

9. Quick cooking rice kernels according to claims 5 to 8 wherein the sponge like structure contains per kernel less than 5, preferably less than 3 holes with a size of more than 500 microns.

10. Quick cooking rice kernels according to claims 5 to 9, wherein the sponge like mass consists of small holes from which more than 75 % have a diameter of 1 to 100 microns.

11. Quick cooking rice kernels according to claims 5 to 10 wherein the kernels have a bulk density of 0.4 to 0.75 kg/l, preferably 0.45 to 0.70 kg/l.

12. Quick cooking rice kernels according to claims 5 to 11, wherein the kernels have a considerable internal coherence so that after cooking for 8 min at about 100 °C less than 20 % of the rice kernels, preferably less than 15 % are broken as a result of the cooking.

13. Process for making quick cooking rice or quick cooking rice kernels with the properties of the rice or the rice kernels from respectively claims 1 to 4 and claims 5-12, wherein milled or polished rice kernels are subjected to a heat treatment in a hot inert gas stream while being in an annular, fluidised bed with a limited height.

14. Process according to claim 13 for the preparation of a quick cooking rice or quick cooking rice kernels with the properties as defined in respectively claims 1-4 and 5-12, wherein rice kernels are subjected to a heat treatment in a hot gas stream in a treatment chamber and wherein the rice kernels are subjected to the heat treatment while being in an annular, fluidised, swirling, toroidal bed with a limited height and wherein the rice kernels have horizontal and vertical velocity components.

15. Process according to claims 13-14, wherein the rice kernels are heated to 200 - 350°C, preferably 240 - 310 °C.

16. Process according to claims 13-14, wherein the rice kernels are treated for 10-60 sec, preferably 15-50 sec, most preferably 20-45 sec in the treatment chamber.

17. Process according to claims 13-16, wherein air is applied as gas.

18. Process according to claims 13-17 wherein the gas is used with a velocity of less than 50 m/sec, preferably less than 25 m/sec

19. Process according to claims 13-18, wherein the gas is recirculated in the process during and after separation of the rice kernel particles.

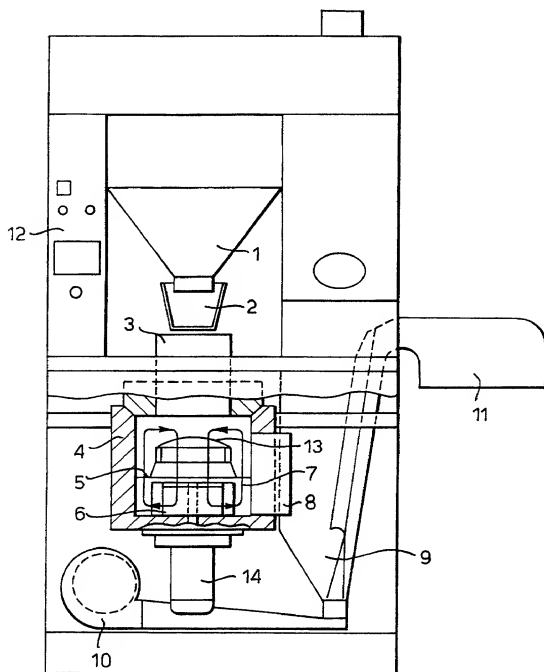
20. Process according to claims 13-19, wherein the gas is recirculated using an air impeller with a rotation speed of 60 Herz or less, preferably 50 Herz or less.

21. Process according to claims 13-20, wherein the water content of the starting rice kernels is 5-40 wt%, preferably 10-20 wt%.

22. Rice containing meals, wherein the rice in the meals is a cooked rice obtained after quick cooking of the rice or the rice kernels according to respectively claims 1-4 and 5-12.

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Fig.1.





COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)

Attorney Docket No F7483 (v)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

QUICK COOKING RICE AND PROCESS TO MAKE

the specification of which (check only one item below).

☐ is attached hereto.☒ was filed as United States application Serial No. 09/889977 on 25 July 2001 and was amended on _____ (if applicable)☐ was filed as PCT international application PCT/EP99/10288 on 20 December 1999 and was amended under PCT Article 19 on _____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. 119
EUROPE	99200213.9	26 January 1999	YES
EUROPE	99202837.3	1 September 1999	YES

I hereby claim the benefit under Title 35, United States Code §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code §112. I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application.

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120.

U.S. APPLICATIONS		STATUS (CHECK ONE)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.

PCT APPLICATION NO.	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)		
PCT/EP99/10288	20 December 1999			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agents(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

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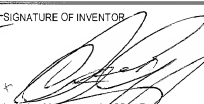
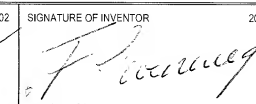
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR  Johannes Cornelis BLONK	SIGNATURE OF INVENTOR  Leendert Marinus van der GRAAF	SIGNATURE OF INVENTOR  Fransiscus GROENEWEG
DATE 26 th November 2001	DATE 26 th November 2001	DATE 26 th November 2001

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications)	Attorney Docket No. F7483 (V)
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POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agents(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

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204

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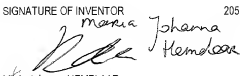

205

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 204  Sander ten HAVE	SIGNATURE OF INVENTOR 205  Maria Johanna HEMELAAR	SIGNATURE OF INVENTOR 206  Ridwan SARWIN
DATE 26 th November 2001	DATE 26 th November 2001	DATE 26 th November 2001